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Note.—As far as possible, the country of origin quoted in the items refers to the original source.

MAIN INDEX.



SUBSIDIARY CLASSIFICATION.

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*Aircraft Recognition—German, Italian and British Types.* (Published by Spohr with the co-operation of the German Air Ministry, Autumn, 1941.) (98/1 Germany.)

This booklet (128 pages) gives principal characteristics of 13 German, 9 Italian and 38 British types. According to the introduction by Field Marshal Milch, the information is mainly intended for pre-military training in connection with the official Aircraft Recognition Section of the German Air Force. After a preliminary chapter dealing with the particular employment of basic types (bomber, fighter, reconnaissance, etc.) and the nature of their armament (bombs and guns), the principles of aircraft recognition are described. This recognition is based on " general " and " special " characteristics.

### GENERAL CHARACTERISTICS.

Number of wings (*i.e.*, mono or biplane).
Number of engines and whether single or tandem.
Type of rudder control (single or twin).
Type of undercarriage (fixed, retracted, floats, flying boat).

DETAILED CHARACTERISTICS.

(*a*) Wing.
(*b*) Power plant.
(*c*) Control surface.
(*d*) Undercarriage.
(*e*) Fuselage.

(*a*) Position and shape (middle, high, low, dihedral, plan).
(*b*) Position relative to wing, cowling, pusher or tractor.
(*c*) Rudder and elevator details—
Position of twin rudder relative to horizontal tail plane.
Position of elevator plans with regard to fuselage.
(*d*) Retracting into wing, engine, nacelles or fuselage.
(*e*) Shape of fuselage (single or twin)—
Streamlined, bulbous, square, recessed, etc.

The reference to the German and Italian aircraft are limited to three photographs of each type, the general and detailed characteristic being limited to a minimum.

The section dealing with British aircraft contains silhouettes as well as photographs and details as to crew, armament and performance are given as well as recognition details.

*Aircraft Attack on Tanks, with Special Reference to the Russo-Japanese War.* (T. Weber, Flugwehr and Technik, Vol. 3, No. 11, Nov., 1941, pp. 254-257.) (98/2 Switzerland.)

The thickness of the armour plating of the British tanks in the 1914-1918 war was of the order of 15 mm. (front), 10 mm. (side) and 6 mm. (top).

Modern medium tanks (20-ton) have a turret armour of about 25 mm., whilst Russian heavy tanks go to 35 mm. and super heavies (type Klim Woroschilov) are said to possess armour up to 70 mm. thick. According to the author, the armour piercing shell of a 20 mm. aircraft cannon will pierce the soft armour plate favoured by the Russians (the German tanks use hardened steel plates, which, although offering more resistance to heavy calibre shells, are stated to be more likely to crack).

The Germans claim to have destroyed a considerable number of Russian medium tanks by this means, the fighter attacking from the rear at low level. A rear attack is favoured, since the tank armour is weakest in this section due to weight of the engine, always installed at the back. Of course, tanks can also be attacked by dive bombers. In this case even a near miss may incapacitate the tank by the effect of the blast (jam gun turret or dismantle tractor chain).

The cannon attack has the advantage that the aircraft can fly over the target a number of times, till the ammunition is depleted. A dive bomber after it has dropped its load must return to its base. High level bombing attack may achieve outstanding successes, if the tanks can be surprised whilst refuelling (danger of fire). The author is of the opinion that attack by aircraft either with cannon or bomb is at least as effective as those carried out with special anti-tank guns (assuming that the latter are available in the positions required) and that this is reflected in the German claims of successes.

At the moment, most tanks do not incorporate anti-aircraft guns in their armament. Until this is remedied, the attack of aircraft will continue to be effective.

*Parachute Jumps from High Speed Aircraft.* (E. Muhlemann, Flugwehr und Technik, Vol. 3, No. 11, Nov., 1941, pp. 266-270.) (98/3 Switzerland.)

If the parachutist opens his parachute whilst travelling through the air at a speed in excess of 250 km./h., the normal parachute is likely to burst. It is therefore necessary to wait with the opening, till the speed of drop has reached a safe value ($\simeq$ 65 m./sec.).

The author calculates the trajectory of the human body for a series of initial values of the speed (100 to 250 m./sec.) and four positions of the original tangent to the trajectory (0°, −30°, −60° and −90°), on the assumption that the terminal velocity of a free drop=61 m./sec. and weight of body=90 kg. From this he deduces the minimum delay time for the opening and the minimum altitude from which a jump can take place. If, for example, a fighter aircraft flying horizontally at 540 km./h., the delay time is 3.7 sec. and the minimum altitude 115 m. If diving vertically at 720 km./h., $t$=8.9 sec. and the minimum altitude 920 m. Cases may arise where the pilot is forced to leave the aircraft at altitudes below the minimum value for the initial speed conditions.

The full delay time is now obviously out of the question, but he may escape with his life if he waits with the opening till about 150 m. from the ground. This will require great presence of mind and at the same time an accurate eye for ground clearance. The latter quality can be trained.

*Why are the German Fighters Superior.* (Luftwissen, Vol. 8, No. 11, Nov., 1941, pp. 336-337.) (98/4 Germany.)

The German fighter Me. 109 has been designed mainly for speed and high rate of climb, whilst the British Spitfire represents a compromise, speed and rate of climb being to some extent sacrificed with the object of increasing the manœuvrability (sharp turns) and achieving a low landing speed. Broadly speaking, these differences are directly due to the smaller relative wing area of the German design, *i.e.*, the wing loading of the Me. 109 is greater than that of the Spitfire.

It is true that at very high altitudes, the induced resistance becomes of increasing importance and the small wing machine is thus handicapped. Up to 20,000 feet, however, the highly loaded Me. 109 has the higher speed and rate of climb, and with this advantage its performance enables it generally to choose the instant and position of attack, with the added advantage of a possible surprise. It is true that in a " dog " fight, the sharp turns of the Spitfire might prove of advantage, but there is nothing to force the German pilot to adopt such tactics for long, since his higher speed will enable him to break off the engagement at any time and renew it at will. It must also be remembered that the main object of the fighter is to work in co-operation with the bomber. Here dog fighting tactics necessarily lead to the escort losing touch with its bombers. The fighter with the higher speed, even if he does not shoot down his opponent, will have already achieved part of his object, since he will be the first to catch up the bomber formation.

In short, speed is the characteristic of attack, manœuvrability that of defence, and in a war experience has shown that attack generally scores.

*Focke Wulf Fw.* 189 *Short Range Reconnaissance Plane.* (H. Conradis, Luftwissen, Vol. 8, No. 11, Nov., 1941, pp. 352-353.) (98/5 Germany.)

This aircraft is of the twin boom type and the central cockpit is characterised by exceptionally good views, special anti-dazzle devices against searchlights being fitted.

Take-off and landing runs are small and the landing gear is sufficiently robust for front line flying fields of poor surface quality. Especial attention has been paid to the comfort of the crew of three. The pilot is seated on the left with the observer on his right. The latter's seat moves on rails and in its rearmost position turns through 90°, enabling him to operate a mobile machine gun or wireless. In the foremost position he controls the automatic camera. The third member of the crew operates the rear gun, whilst the fixed guns are under the control of the pilot. Light bombs for ground attack are also carried. The armament is thus considerable, and although not primarily intended for aerial combat, it is stated that the machine has been able in the course of its reconnaissance duties on the Russian front to dispose of several enemy bombers. Exhaust heating is applied to the cabin and to the leading edge of the wing (de-icing). Blind flying can then be carried out in safety and comfort. This is of special importance for surprising the enemy or escaping from fighter.

It is stated that the aircraft will fly successfully on one engine and that it has been designed specially from the point of view of mass production.

*Modern Problems in Military Aircraft Construction.* (G. Bock, Flugsport, Vol. 33, No. 26, 24/12/41, pp. 497-499.) (98/6 Germany.)

When we compare the Me. 109 with the Fokker D VII (the most successful fighter of the 1914-1918 war) we find that the weight has been increased three times whilst the speed has been increased three and a half times for a seven-fold increase in engine power. The modern fighter is aerodynamically much more efficient than its predecessor and a considerable proportion of the total speed increase (over 50 per cent.) must be put down to this account. It appears that in the Me. 109 the limit of practical wing loading has approximately been reached. As is well known excessive wing loading, although of great advantage over the normal altitude range, detracts from the performance at very great heights. Whilst a further cutting down of the wing surface is thus not feasible, the alternative of reducing the drag by maintaining a laminar boundary layer deserves the closest attention. Boundary suction control in connection with high lift devices for landing also offers an interesting possibility.

At high speed, the normal aircraft controls require a considerable amount of force for their operation and according to the author, new control surface shapes are now available which are much less fatiguing to the pilot. It is interesting to note that for normal aerofoils at constant incidence, the lift obeys the square law up to about 800 km./h. At 900 km./h., the lift however falls, and what is more important, the C.P. travels forward. At 950 km./h, the C.P. is in front of profile, but travels suddenly to the rear at 975 km./h. This change in C.P. position will render control at such speeds extremely difficult. Research, however, indicates that more stable profiles can be evolved. Speeds of this order, although beyond the present day range, are considered possible in the near future provided higher engine boosts become available. In this connection the exhaust driven supercharger is receiving full attention.

In conclusion the author stresses the great importance of armament on aerodynamic efficiency. Proturbances due to present day gun mountings, etc., offer a considerable amount of resistance at speed and considerable improvement should be possible by careful installation.

*Aircraft and Torpedo.* (Inter. Avia., No. 793, 5/12/41, pp. 1-3.) (98/7 Switzerland.)

The question of the necessity of the control and propulsion devices of the naval torpedo already raises a host of problems. It would seem to be quite feasible that in the case of small distances of attack the aircraft torpedo need not be provided with a special means of propulsion if only a small portion of the trajectory to the target leads through water. Equally advantageous would be the possibility of doing without the extremely delicate control mechanisms of the naval torpedo, its directional device and its depth control mechanism with the auxiliary control instruments and, choosing a suitable weight and buoyancy distribution, of increasing the height of the torpedo release. Any development along this line will depend above all upon the question as to whether a torpedo attack from a short distance will be possible at all in the face of heavy defensive fire on the part of the warship. It is just as easy to anticipate that great distances of attack may become necessary and hence that the torpedo will have to be provided with an improved means of propulsion. But it should always be endeavoured to obtain the greatest reduction in the water trajectory of the torpedo in favour of the longest air-borne distance; whether or not this goal can be attained with the help of ejector mechanisms in the aeroplane, by means of jet propulsion or by the addition of buoyancy surfaces to the torpedo, will be taught by the experiments.

*Gliders, as Troop Carriers, in the War Against Crete.* (La Science et la Vie, Vol. 60, No. 290, Oct., 1941, pp. 194.) (98/8 France.)

The type of glider illustrated was used as a German troop carrier in Crete. The glider has a wing span of 21.3 metres, and wing area of 27 metres$^2$. It is capable of carrying eight soldiers, and has a weight of 900 kg. including crew. When abandoned, its greatest speed of descent is only 1.22 m. per sec. This, however, enables it to manœuvre a suitable landing position, and to choose its site, which the parachutist is unable to do, and comes to rest safely on its spring keel. Contrary to belief, the speed of the towing aircraft is hardly affected by the glider train.

The Junkers Ju. 32, used as a tug in the war against Crete, has three engines. (Its civil version can carry 27 passengers.) It has been employed in Norway and Holland for transport of troops, and in Libya for refuelling purposes. It is capable of towing a train of from three to six gliders, which carry crews of twenty-four to forty-eight men, respectively.

The four-engined Focke Wulf " Kurier " has a wide radius of action and plays a very active part in the Atlantic region in waging war on British convoys. This machine can tow a train of eight to ten gliders, carrying crews of sixty-four to eighty men.

*Lilienthal Competition* 1940 *Winners in the Section Dealing with Aircraft Design.* (Luftwissen, Vol. 8, No. 11, Nov., 1941, p. 358.) (98/9 Germany.)

The title of the problem set in this section was: Investigations on the transition from laminar to turbulent flow in the boundary layer on aircraft wings.

From a design point of view, it is obviously an advantage to delay this transition as long as possible and then reduce the friction drag of the wing. Altogether nine papers were submitted of which six were awarded prizes. It is interesting to note that of these only one dealt with the experimental aspect of the subject, the remaining five being of a purely theoretical nature. The calculation of the boundary layer velocity profile has been either simplified by determining profiles depending only on a single form parameter (extension of Pohlhausen's investigation) or rendered more accurate by making fuller use of the Prandtl differential equations in addition to the impulse theorem.

It appears that the present state of theory is unable to predict the position of the transition point on the wing and we have to be satisfied with the location of the beginning of instability in the laminar layer.

In this connection the two papers sharing the first prize represent a notable advance on the fundamental work of Tollmien.

*Theoretical Correction for the Lift of Elliptic Wings.* (R. T. Jones, J. Aeron. Sci., Vol. 9, No. 1, Nov., 1941, pp. 8-10.) (98/10 U.S.A.)

The correction commonly applied is that introduced by Prandtl and known as the lifting-line theory. The down flow induced by the wake is considered, in this theory, to reduce the relative normal velocity and hence the edge velocity of the wing. It is assumed, however, that once the true angle of attack is determined for any section of the wing its effect in producing circulation and lift is the same as in two-dimensional flow. This assumption is expressed by the equation

$$C_L = 2\pi(\alpha - \alpha_i) \qquad \qquad (1)$$

where $2\pi$ is the slope of the lift curve for the thin wing of infinite aspect ratio, $\alpha$ is the angle of attack of down flow.

Eq. (1) takes into account the effect of the wake in diminishing the relative normal velocity of the wing. A further correction is indicated by the fact, established in hydrodynamic theory, that the surface velocities induced by a given relative motion of a body in three-dimensional flow are generally smaller than those in two.

In the case of an elliptic disc the velocity at every point is reduced by the factor $1/E$, where $E$ is the ratio of the semi-perimeter of the ellipse to the span.

The corrected formula for the lift is then

$$C_L = (2\pi/E)(\alpha - \alpha_i) \qquad (2)$$

Since the velocity of the non-lifting potential flow is constant all around the edge of the elliptic plate, the circulation required will be proportional to the chord at each section. The circulation is thus elliptically distributed spanwise. Such a distribution, with the chordwise distribution assumed earlier, leads, as in the lifting-line theory, to the relation

$$\alpha_i = C_L/\pi A \qquad (3)$$

where $A$ is the aspect ratio.

Substitution of this value into Eq. (2) gives

$$C_L = 2\pi\alpha A/(EA+2) \qquad (4)$$

Since the chordwise distribution of the circulation in three-dimensional flow is assumed similar to that in two, and since the similarity is only proved for the non-circulatory flow, Eq. (4) must be considered a correction of the wing section theory rather than a solution of the three-dimensional problem. The assumption of similarity, although its validity is subject to somewhat the same limitations in general, appears to be a more justifiable one than the assumption of equality made in the lifting-line theory.

It is found that the additional correction to the wing section theory accounts for an appreciable fraction of the loss in lift that is usually attributed to viscosity. It has been difficult to reconcile the magnitude of the inefficiency with the observed dimensions of the wake, which in the case of smooth wings, is extremely narrow at the trailing edge. The foregoing correction accounts for as much as half of this discrepancy in cases of wings with sharp trailing edges.

*Supersonic Flow Through Turbines and Compressors.* (K. W. Sorg, Forschung, Vol. 10, No. 6, Dec., 1939, pp. 270-285.) (R.T.P. Translation No. 1,327.) (98/11 Germany.)

As is well-known, the adiabatic expansion of a gas is accompanied by a contraction of the stream lines, minimum cross-section occurring when the local velocity of sound is reached. This, however, only applies if there is no absorption or introduction of mechanical energy into the stream. In the flow through turbines or compressors, such an exchange of energy necessarily takes place and is accompanied by change in the K.E. of the flow. As a result, minimum cross-section may occur at values of the Mach number greater or less than unity, and in certain cases a minimum may not be reached. The author investigates this effect more closely for different types of impellers, paying special attention to the occurrence of the so-called compression shock. The conditions for a shock are the same as that for a minimum cross-section.

It is, however, interesting to note that the velocity giving rise to the shock wave is not equal to that of the local velocity of sound, as defined by $\sqrt{dp/dp}$. This is due to the fact that $\sqrt{dp/dp}$ no longer represents the velocity of propagation of small amplitude waves if mechanical energy is added to the stream.

As regards practical applications, the author differentiates between shock waves arising in the diffuser or in the impeller. For normal types of axial and radial compressors, compression shocks are much more likely to arise on the vanes of the diffusor than in the impeller itself; for this reason the author recommends vaneless diffusors as forming the simplest solution for high speed operation. This, of course, presupposes that the blade number on the impeller is sufficiently high to prevent excessive differences in the discharge velocity across the blade passage.

*Aircraft Collision with Birds—New Windshield Proposals.* (American Aviation, Vol. 5, No. 13, 1/12/41, pp. 40 and 47.) (98/12 U.S.A.)

According to Department of Agriculture migration authorities, the possibility of bird-plane collisions is greatest at around 1,000 feet altitude—the most common level for mass bird movements. Migrations at over 3,000 feet are considered rare, although lone birds are to be found considerably higher.

While the 61 cases on which data have been gathered by Beard do not represent a complete report of actual hits in the past few years, analysis of the totals does give some indication of how the present wind-shield glass stands up against the impacts. Of tht 61 hits, the wind-shield was struck 27 times (44 per cent. of the total), other parts of the plane being damaged in 34 instances (56 per cent. of the total).

In the 27 instances where birds struck the wind-shield, the glass was damaged as follows:—Broken and shattered ten times, cracked eight times, and undamaged nine times.

*The Acceleration of Gliders Catapulted by Means of a Rubber Cable.* (F. Kramer, Luftwissen, Vol. 8, No. 11, Nov., 1941, pp. 344-347.) (98/13 Germany.)

The acceleration during the launching process was calculated from the load/extension curve of the rubber cable. The friction between cable and ground during the motion is allowed for.

The maximum acceleration obtained with two 36 m. cables of 1,000 strands each, when stretched to 65 m. at an angle of 15° on either side of the glider axis amounts to about 7-8 m./sec.$^2$ for the usual glide weight of 200-250 kg. Under this condition and in the absence of wind, the take-off time is of the order of 2.7 sec. and the run 28 m.

By reducing the weight to 150 kg. and using 100 per cent. extension of the cables, the acceleration can be increased about threefold.

*On Propeller Tip Interference Due to the Proximity of a Fuselage.* (A. Gail and H. S. Lee, J. Aeron. Sci., Vol. 9, No. 1, 1941, pp. 11-16.) (98/14 U.S.A.)

The periodic changes of the air forces acting on a propeller blade element that passes by the flanks of a fuselage nose are theoretically investigated. This forcing function known to excite vibrations of propellers and aeroplane structure is harmonically analysed. The strength of the fundamental harmonic and the relative strengths of the higher harmonics are found to be greatly dependent upon the location of the propeller plane downstream from the fuselage nose and upon the ratio of fuselage diameter to propeller diameter.

The farther downstream the propeller is located behind the fuselage tip and the greater the fuselage diameter compared to the propeller diameter, the smaller is the intensity of the fundamental harmonic and the smaller is the relative importance of the higher harmonics of these propeller tip excitations.

The clearance between propeller tip and fuselage flank is found to have comparatively little beneficial effect within the usual limits at the designer's disposal.

The simplifying assumptions of this analysis restrict the validity of the results to fuselage shapes corresponding to a Rankine point-source half-body in flow of axial symmetry and propeller locations one fuselage diameter or more down stream from the fuselage bow.

Experimental verifications of this analysis and an investigation of oblique flow about the fuselage are desirable.

*An Approximate Method to Predict the Transition or "Flare" Flight Path in the Take-off or Landing of an Aeroplane.* (O. Welling, J. Aeron. Sci., Vol. 9, No. 1, Nov., 1941, pp. 17-23.) (98/15 U.S.A.)

The nature of the transition phase of the take-off and landing of any aeroplane is briefly discussed in which it is shown that, in the usual case, the two manœuvres are virtually identical physically, since in each the aircraft may be considered to be a free body being simultaneously accelerated by two mutually perpendicular forces between similar end conditions. It is also shown that the time histories of the two accelerating forces are in each case so interrelated that one determines the other and that therefore the pilot may control the time history of one of the forces directly, in which case that for the other is automatically determined; or he may indirectly control the time history of the other force through his direct control of the one, in which case the necessary time history for the directly controlled force is automatically determined; but he cannot exercise independent control over both forces in any case.

Typical time histories of these forces have been obtained for one aeroplane in take-off and for two aeroplanes in landing by means of step-by-step integration of the summation force equations which may be written. From these solutions it appears that the possible time histories which will satisfy a given set of end conditions lie within fairly narrow limits. Based upon a simple geometrical approximation to the form of these typical time histories, a method is presented by means of which to predict the flight path in terms of the initial and final values of flight path and climbing or sinking speeds and of the thrust and/or drag characteristics of the aeroplane.

It may be noted that the method neglects such secondary efforts as the reduction in induced drag due to proximity to the ground or the gradient with respect to height above the ground which is usually present in the wind velocity. Neither of these effects appears likely to make significant difference in the typical form of the time histories of the accelerating forces, upon the assumed simplification of which the validity of the entire method rests. Allowance for the change in magnitude of the forces due to these effects may be made in the selection of the proper values to be inserted in the equations. The accuracy of the results of any practical application of the method, however, must depend upon the precision with which the pilot can control the climbing airspeed in take-off or the approach gliding airspeed in landing. For this reason it appears that all such secondary effects may be neglected without introducing significant error. This feature is also common to the generally accepted methods for calculating the flight paths for the other two phases of the complete take-off or landing.

*Aeroplane Vibration Tests as Related to the Flutter Problems.* (C. B. Lyman, J. Aeron. Soc., Vol. 9, No. 1, Nov., 1941, pp. 24-30.) (98/16 U.S.A.)

The flutter problem has been treated analytically by several authors, but an attempt will be made in this paper to summarise the general problem as one of the aircraft designer and to demonstrate how the aircraft vibration test may be employed as a powerful tool in its solution.

The designer's problem is to determine in the early stages of an aircraft design the minimum flight velocity at which aerodynamically energised oscillation of a component aerofoil surface or combination of surfaces is possible and, to incorporate design features which will assure that this critical flutter velocity will exceed the maximum velocity at which it is intended to operate the aeroplane. In short he must know (1) what factors governed by design affect the flutter characteristics, (2) how to measure and evaluate these factors, and (3) how to determine from the measured values of these factors, with a reasonable degree of accuracy, the value of the critical flutter speed inherent with his design. It cannot be said, however, that there are as yet available completely satisfactory routine methods applicable to calculating the flutter speed of all aircraft components. The aircraft designer can, however, by applying basic principles control certain of these measured factors by design so that there is reasonable assurance that the flutter characteristics of the aircraft are at least qualitatively influenced in the proper direction.

There is every indication that, in the very near future, a designer possessing reasonably accurate values of the flutter parameters applicable to his design will have available methods and procedures by which he either can accurately calculate the critical flutter velocity or he can determine at least whether or not the aircraft will be aerodynamically stable throughout the intended range of operating speeds.

It is hence apparent that the measurement of the flutter parameters is an important and essential problem. It is the primary purpose of this paper, then, to outline the technique of the laboratory vibration test and to describe in what ways it contributes to solving the problem through the measurement of necessary data.

*Vibration Characteristics of Three and Four-Bladed Airscrews.* (R. M. Guerke, S.A.E.J., Vol. 49, No. 6, Dec., 1941, pp. 542-552.) (98/17 U.S.A.)

Although some reference is made to engine excitation the author is mainly concerned with blade vibrations induced aerodynamically by airscrew body interference. The problems involved in developing a satisfactory engine propeller aeroplane installation using propellers of four or more blades are admittedly more difficult than those encountered with a three-blade propeller. However, experiences gained so far with these propellers seem to indicate that a satisfactory installation can be made if the aeroplane designer will assume the responsibility of reducing propeller interference effects. This, of course, may be very difficult if not impossible to accomplish in "pusher" installations. However, if it can be accomplished in a normal tractor four-blade propeller installation without recourse to odd blade spacing, and two such installations have been made, it also can be accomplished in five or more blade propellers under similar installation conditions. Dual-rotation propellers will introduce additional propeller design problems of a vibration nature which may require certain compromises in diameter, blade construction, and engine gear ratios before satisfactory installations can be made. However, it is believed that these can be made without sacrificing aeroplane performance.

*The Importance of the Aerodynamic Moment Acting on the Blade in the Design of Variable Pitch Mechanisms.* (G. Cordes, L.F.F., Vol. 18, No. 11, 20/11/41, pp. 373-377.) (98/18 Germany.)

The aerodynamic moment about the blade axis plays an important part in determining the forces required to actuate the pitch mechanism. The author shows how this moment can be determined from the lift distribution and points out the great simplification obtained by introducing the concept of the equivalent wing polar diagram originally due to von Doepp (L.F.F., Vol. 13, No. 2, 1936).

From the study of such diagrams it appears that the moment is always positive under take-off conditions and negative when carrying out a high speed dive, whilst approaching zero when cruising. During a dive, therefore, the aerodynamic moment opposes the control force which must increase the blade pitch so as to maintain the r.p.m. constant. If the pitch changing mechanism is sluggish in its action, there is thus danger of the engine racing. Although it is possible for any given set of conditions to balance the aerodynamic moment by means of balance weights, such devices may make matters worse under other conditions of operation. A possible solution is to use as small a blade width as possible for the original airscrew design and thus decrease the aerodynamic moments directly. Unfortunately this entails increasing the total number of blades.

*Airscrew Blade Stresses Due to Periodic Displacement of the Airscrew Shaft.* (J. Meyer, L.F.F., Vol. 18, No. 11, 20/11/41, pp. 383-386.) (98/19 Germany.)

Displacement of the airscrew shaft subjects the blades to a combination of inertia forces and moments acting in the airscrew plane together with gyroscopic moments acting at right angles to this plane. The author evaluates the bending moments acting on the blade arising from these two causes, and shows that their maximum values are doubled if the shaft executes a circular path (two degrees of freedom) instead of vibrating linearly (one degree of freedom). Whilst a completely elastic support of the airscrew on the shaft is not feasible, the author shows that a partial balancing of the gyroscopic moments by means of suitably placed springs is possible. Since in most practical cases, the gyroscopic moment is at least of the same order of magnitude as that produced by inertia forces, this solution should go a long way towards reducing blade stresses due to blade displacement of the shaft. The author calculates the elastic constants of a suitable spring for a practical case, and shows that its use does not introduce criticals in the working range.

*On the Automatic Regulation of Output in Centrifugal Compressors.* (V. F. Ries, Sov. Kotloturb, No. 8, Aug., 1940, pp. 261-269.) (98/20 U.S.S.R.)

The article discusses the means of augmenting the pressure in the intake or discharge of a centrifugal compressor to obtain a sufficient governing force for operating the automatic output governor. The devices suggested are: Plain orifice plates; shaped nozzles; combinations thereof; venturi tubes, single or multiple; and a "pressure multiplier" of the author's design, consisting of an orifice plate in combination with a venturi tube.

After a full theoretical analysis of the resulting flow conditions, degree of pressure multiplication and losses in and caused by the device adopted, the following conclusions are arrived at:—

(1) The magnitude of the obtainable pressure differential depends not only on the form of device adopted, but also on its position, *i.e.*, whether on the intake or discharge side of the compressor.

(2) Orifice plates, on account of their simplicity, are preferable to nozzles, except for gases carrying a large percentage of tarry impurities.

(3) For *uncooled* compressors, orifice plates and nozzles are unsuitable owing to their high power losses.

For *cooled* compressors, orifice plates and nozzles are quite suitable if arranged on the discharge side. The author's type of "pressure multiplier" is suitable for installation on the intake side.

In general, having regard to the range of sensitivity of the governor and the power losses involved, regulation from the discharge side appears more effective than regulation from the intake side.

It is admitted that a number of the propositions set up in this article still await experimental confirmation.

*Determination of the Natural Frequency of Turbine Blades.* (J. K. Chernishevsky, Sov. Kotloturb, No. 8, Aug., 1940, pp. 269-273.) (R.T.P. Translation No. 1,389.) (98/21 U.S.S.R.)

The four principal factors determining natural frequency of blades are:—

(1) Blade shape at root.
(2) Surface finish.
(3) Clamping force.
(4) Blade length.

Although methods of frequency calculation exist, the mathematical formulation of some of the above factors present great difficulties and as a result, the author recommends a rational system of experimental correction coefficients, to be determined by collaboration of the whole industry.

With the introduction of such coefficients the deviation of the calculated from the true frequency is reduced, the main uncertainty being lack of uniformity in the blade clamping.

*Mechanical Supercharging of Diesel Engines (with Discussion).* (H. L. Knudsen, S.A.E.J., Vol. 49, No. 5, November, 1941, pp. 481-487.) 98/22 U.S.A.)

The most serious problem arising from higher degrees of supercharging is the increase in exhaust temperatures and the amount of additional heat to be handled. This conclusion is expressed following a theoretical exploration into the possibilities of supercharging and the ultimate limit to which it is possible to go. Efficiencies which may be expected with increasing degrees of supercharging, with and without compressor intercooling, are predicted. Indicated m.e.p. of the order of 200 psi at reasonable fuel economy (0.4 lb./b.h.p. hour) are claimed.

Some of the present-day supercharges are discussed, including the Roots, vane, centrifugal, and exhaust turbo-type blowers, and the advantages and disadvantages of each are given.

Preference is given to the Roots type for engines of medium power range.

*The Allison Aircraft Engine Development.* (R. M. Hazen, S.A.E.J., Vol. 49, No. 5, November, 1941, pp. 488-500.) (98/23 U.S.A.)

This paper recounts, step by step and model by model, the development of the Allison V-1,710 aircraft engine—the first liquid-cooled military aircraft engine in production in this country.

Since 1930, when the design of this V-type 12-cyl. engine was initiated, the power plant has been stepped up from 650 h.p. without supercharging to 1,000-1,500 h.p. in its supercharged state, and the weight has increased from about 1,000 lb. to 1,320 lb., the author reveals.

The following three underlying reasons are given for building the first V-1,710 engine:—

1. That the V-12 type of construction with its small frontal area could be installed with less drag than any other type of engine.
2. That a liquid-cooled engine could be operated at a higher power output per cubic inch due to the type and uniformity of cooling.
3. That the liquid-cooled engine would be more reliable because it is less sensitive to temporary overloads on account of the heat capacity and limiting temperatures (boiling) of the coolant.

Additional advantages discussed are flexibility of radiator installation and of engine location.

*Design of Airscoops for Aircraft Carburettors (with Discussion).* (M. J. Kittler, S.A.E.J., Vol. 49, No. 5, November, 1941, pp. 501-512.) (98/24 U.S.A.)

With the increasing use of fully automatic carburettors, it was found to be more and more important to make sure that all elements of the installation were carefully worked out so as to insure accurate metering of the carburettor under all operating conditions. Experimental flight investigations demonstrated that this was particularly true of the carburettor airscoop which admits the air to the carburettor and can therefore cause flow disturbances which may seriously affect carburettor metering.

Test laboratory investigations were made of a considerable number of airscoops in an effort to determine what factors contributed to the proper or improper functioning of the scoop. It was found that the shape and size of the scoop passages and also the location of the hot air valves were important factors, and a number of general design criteria were formulated, and these are discussed in detail. A discussion of the ram characteristics under various conditions of flight and for various sizes of scoop is also included.

An actual production model of airscoop was designed in which these various features were included. The aerodynamic and structural features of this airscoop are discussed and explained in detail.

Five simple rules are given to assist the designer in laying out an airscoop which will incorporate the design features which were found to be desirable.

*Compression-Ignition Engine Performance at Different Intake and Exhaust Conditions.* (M. A. Elliot, S.A.E.J., Vol. 49, No. 6, Dec., 1941, pp. 532-543.) (98/25 U.S.A.)

Because of its basic nature and because it did not appear to be affected by changes in ambient conditions, the relation between indicated efficiency and fuel-air ratio offered a rational basis for correcting the performance of compression-ignition engines for changes in ambient conditions. Accordingly, rational equations were derived for computing either the indicated or brake horse-power at some standard condition of intake temperature and pressure from the fuel consumption and horse-power determined at any other intake temperature and pressure. Simplified approximate equations are also presented. A comparison of horse-power ratios computed from the equation with horse-power ratios determined experimentally indicates satisfactory agreement throughout a wide range of intake conditions.

It is pointed out that operation of compression-ignition engines at constant speed and throttle setting is characterised by a constant rate of fuel input and therefore comparisons should be made on this basis. In contrast with this, at constant speed and throttle setting, a spark-ignition engine equipped with a carburettor approaches operation at a constant fuel-air ratio and therefore with such an engine comparisons should be made on this basis. Formulas applying to this latter condition are discussed briefly.

*Chrome Hardening of Cylinder Liners.* (H. Van der Horst, S.A.E.J., Vol. 49, No. 6, Dec., 1941, p. 38.) (98/26 U.S.A.)

Many experiments and many installations—well over a hundred thousand engines, chiefly Diesel—show that chrome plating of cylinder bores is an excellent remedy for wear. Not only is cylinder wear decreased by chrome plating, but wear of cast iron piston rings is decreased to about one-fourth when running in chrome barrels.

Concerning the application of chromium to cylinder liners, the following must be noted. The electrolytic coating must adhere perfectly; the thickness of the coating must, within limits, be equal all around and from top to bottom; there must be no tiny ridges for the piston or the rings to run against; the ordinary bright, dense coating of chromium is not suitable as it does not hold lubricating oil; and in order to hold oil, it is essential that the chromium be very porous.

The difference between ordinary chromium plating and the kind required for cylinder liners is most marked. The technique is of extreme importance and is generally covered by patents.

*Practical Example of Aero Engine Superchargers.* (W. von der Null, Z.V.D.I., Vol. 85, No. 47-48, 29/11/41, pp. 965-913.) (98/27 Germany.)

Centrifugal supercharger installations for the following engines are described in some detail for the following engines:—

(1) Hirth H.M. 508C (270 h.p. 8-cylinder V air-cooled).
(2) Rolls-Royce Merlin.
(3) Hispano Suiza 127.

(4) Junkers 210.
(5) Bristol Pegasus and Hercules.
(6) Wright Cyclone.

Some reference is also made to the D.V.L. supercharger and two-speed gear, the Hispano Suiza nine-stage axial blower and a proposed combined axial-centrifugal supercharger. Of interest are test results obtained by the D.V.L. on a Merlin II and Hispano supercharge respectively.

In spite of the higher theoretical efficiency of the axial type of compressor, the very steep characteristic of this design is a serious drawback in engine supercharging. The need for maintaining small blade tip clearance over a relatively long casing also presents great difficulties, since at least nine impellers have to be accommodated on one shaft in order to produce the necessary pressure head.

According to the author, the axial type of supercharger is only of interest at high altitudes when type acting as the first stage of a centrifugal blower. At such very low intake densities, it is difficult to obtain a sufficient entry area without a considerable increase in the rotor diameter of the purely centrifugal type. The axial type does not suffer from this trouble to the same extent and, by supplying a compressed charge to the centrifugal blower, the overall diameter of the combination can be considerably reduced.

*Numerical Calculation of the Power Variation with Altitude in a Naturally Aspirated Four-Stroke Carburettor Engine by Means of the J.S. Diagram.* (K. Tanaka and others, Aeron. Res. Inst., Tokio, Report No. 204, Feb., 1941.) (98/28 Japan.)

The authors calculate the theoretical m.e.p. of a four-stroke engine for various mixture strengths of a petrol/benzol mixture, making allowance for the variation in specific heat and dissociation. The weight of fresh charge aspirated is determined by the pressure and temperature at the end of the suction stroke and such factors as exhaust residue, vapourisation of fuel, heat transmission from cylinder walls and resistance of inlet circuit are duly allowed for. The results are given in a series of graphs showing variation of indicated map with altitude for a series of compression ratios. It appears that the relative drop in indicated power is given very closely by the relation

$$\frac{(\text{I.H.P.})_z}{(\text{I.H.P.})_0} = \frac{P_z}{P_0} \cdot \frac{T_0}{T_z}$$

When $P$ and $T$ are the pressure and temperature of the air the suffixes $z$ and $o$ indicating altitude and ground conditions respectively.

The variation of b.h.p. with altitude depends on the variation of mechanical and pumping losses. From a review of experimental data, the following formula is suggested:—

$$\frac{(\text{B.H.P.})_z}{(\text{B.H.P.})_0} = 1.078 \qquad \frac{(\text{I.H.P.})_z}{(\text{I.H.P.})_0} - 0.078$$

*The Vibration of an Elastically Mounted Engine Fitted with a Two-Bladed Airscrew.* (A. Weigand, L.F.F., Vol. 18, No. 18, 20/11/41, pp. 378-382.) (98/29 Germany.)

The equations of motion of an elastically mounted engine fitted with a two-bladed airscrew contain terms the coefficients of which are periodic functions of the time. Critical speeds seem so far to have only been determined for the vibration with one degree of freedom, although Meyer (German Yearbook of Aerodynamic Research, 1938, Vol. 2, pp. 179-182) was able to give a particular solution for the case of the symmetrical engine which is symmetrically supported.

The author shows how the general system of equation can be transformed so as to reduce the number of unknowns in each equation from the original four or six to two or three. The zero points of the determinants can then be evaluated in the form of continuous fractions which lend themselves to numerical evaluation.

This is illustrated by means of graphs and a table.

*Similarity Considerations Applied to Turbines and Compressors, including Stresses in the Materials.* (E. Eckert, L.F.F., Vol. 18, No. 11, 20/11/41, pp. 387-395.) (98/30 Germany.)

The various dimensionless factors determining similarity of flow of a gaseous medium, are enumerated. In the case of turbines and compressors, the flow and pressure coefficients ($\phi$ and $\psi$) are of importance—these are defined as $c_m/u$ and $h_{ad}/(u^2/2g)$ respectively, where

$c_m$ = axial component of flow at entry.
$h_{ad}$ = adiabetic heat drop available.
$u$ = circumferential speed.

In case of similarity, we have

$$\psi = f\ (\phi,\ Re,\ Ma,\ Pr).$$

where $Ma$ = Mach number.
$Pr$ = Prandtl number.

The influence of Mach number on $\psi$ for axial and radial superchargers over the speed range $u = 150$ to 350 m./sec. appears to be relatively slight.

Similar considerations can be applied to mechanical stresses and bearing loads. From a consideration of all of the above factors, the author concludes that an installation consisting of several turbine or blower units is generally to be preferred from the point of view of power/weight ratio to a single machine of equivalent output.

*The Routine Quantitative Spectrographic Analysis of Magnesium Alloys.* (F. A. Fox and J. Nelson, J. Soc. Chem and Ind., Vol. 60, No. 11, Nov., 1941, pp. 278-286.) (98/31 Great Britain.)

An account is given of the development of the application of the spectrograph to the quantitative analysis of magnesium alloys. Details of a routine method of spectrographic analysis by the "comparison sample" method, are given, and it is shown that for constituents in the range of 0.1 to 3 per cent. an accuracy of $\pm 4.5$ per cent. of the content can be obtained. Aluminium, when present in amounts greater than 4 per cent. cannot be estimated by the method indicated with a mean accuracy greater than $\pm 7$ per cent.

*Bureau of Standards Researches on the Mechanical Properties of Alloys at Low Temperatures.* (Light Metals, Vol. 4, No. 46, November, 1941, pp. 212-215.) (98/32 U.S.A.)

A number of aluminium and magnesium alloys were tested over the temperature range +20°C. to −80°C., the following factors receiving special attention:—

Ultimate tensile.
Yield point.
E.
Elongation.
Reduction in area.
Impact resistance.
Hardness.

The effect of long period exposure to −80°C. before testing the specimen at room temperature was also investigated.

In the case of the aluminium alloys, the effect of the temperature range is a consistent but small increase in all the factors enumerated above. Previous exposure to −80°C. produced however scarcely any effect on the values obtained subsequently at 20°C. For the magnesium alloys, the increase accompanying a lowering temperature is slightly more marked and there is evidence of an appreciable effect of prior exposure to cold for certain of the wrought magnesium alloys.

There is also some evidence that high speed machining operations on automatics are favourably affected by cold (either by flooding with strongly cooled cutting fluid or by refrigerating the material prior to machining).

The effect of cold on fatigue, corrosion and general wear still requires further experimental investigation.

*Recent Experiments in Connection with the Spraying of Steel.* (R. R. Sillifant, Engineering, Vol. 144, pp. 526-528.) (98/33 Great Britain.)

The spraying of various carbon and alloy steels for the purpose of resurfacing and building up worn parts has been adopted as standard practice in many engineering works. The purpose of the author is to explain some experiments carried out by him with a view to improving the quality of the deposit, using a wire fed pistol. These pistols are designed normally to use either compressed coal gas, hydrogen or acetylene as the fuel gas, air being the impelling medium for the atomised particles. Under these conditions each sprayed particle is enveloped by a skin of oxide which reduces the quality of the deposit and reduces its tensile strength. The author concluded that oxidation can occur in four distinct phases, (1) in the flame zone, excess $O_2$ being present; (2) in the air blast on removal from wire; (3) on the surface of the sprayed article, by exposure to air blast; (4) on the surface of the article if the latter becomes excessively heated. Phase (1) and (4) should be considerably reduced by having a neutral flame and keeping the work cool; phase (2) and (3) are avoidable if nitrogen instead of air is used as the impelling medium. It appears that approximately neutral flames of sufficient stability can only be obtained with acetylene. Using this type of flame in conjunction with $N_2$, the author in fact obtained deposits of improved quality, especially after two hours connecting at 900°C. The optimum temperature will depend on the nature of the sprayed material and to obtain the best results, the surface of the article has to be subjected to a preliminary roughening (screw threading at a very fine pitch).

*Shear Strength of Moulded Plastic Materials.* (J. Delmonte, British Plastics, Vol. 13, No. 149, October, 1941, pp. 134-135 and 137.) (98/34 Great Britain.)

The punch and die are described in the measurement of shear strength upon moulded plastics parts as a useful tool for a rapid method of evaluating this property by moulders. Test results upon phenolics and ureas which have been cured for different periods of time are described. It is pointed out that differences in shear values of moulded phenolics are augmented by several minutes immersion in acetone, whereas boiling water may be used to reveal substantial variation in the cure of moulded urea parts and their shear strength. Comparative tests upon a large number of injection-moulded pieces produced in the same mould are outlined, and a table prepared comparing these materials with respect to shear strength. Injection mouldings of polyvinyl chloride-acetate and polymethyl methacrylate proved to be the highest. Further tests designed to show the utility of the punch and die reveal data on the shear strength of moulded plastics as function of temperatures from O° to 300°F.

*Surface Conditions and Fatigue Strength in Steels.* (O. J. Horger and H. R. Neifert, Vol. 85, No. 11, 1/12/41, p. 78.) (98/35 U.S.A.)

Surface rolling of plain cylindrical specimens increased the endurance strength materially, although it increased the surface irregularities. For instance, when specimens of 0.3 in. diameter were rolled with rollers of 7/16 in. diameter and 3/32 in. contour radius, under a pressure of 250 lb. per roller the surface irregularities increased from 30 to 310 micro-inches, and the endurance limit from 39,800 to 52,600 psi (32 per cent.). The authors concluded that rolling makes a greater improvement in the fatigue strength than any form of surface finish, such as machining, grinding, or polishing.

Surfaces on metal parts are sometimes built up by metal spraying, and the question then arises as to what effect this process has on the endurance strength. To get an answer to this question, 2 in. plain cylindrical specimens of S.A.E. 1,035 annealed steel were tested as rotating cantilever beams with and without a sprayed-on coating of steel. The coating was of carbon steel wire (0.40 per cent. carbon), $\frac{1}{8}$ in. thick after machining and polishing. The uncoated specimens had an endurance limit of 30,000 psi, the coated ones of 28,000 to 30,000 psi.

A further subject investigated was the strengthening effect of flame hardening on press-fitted assemblies. Plain cylindrical axies of 2 in. diameter, made by S.A.E. 1,045 steel, normalised and tempered were flame-hardened at the wheel-fit surfaces. By this treatment the endurance limit for breaking off of the axle at the wheel was increased from 13,000 psi for the conventional assembly to 45,000 psi for the flame-hardened sample.

*The Planoflex, a Simple Device for Evaluating the Pliability of Fabrics.* (E. C. Dreby, J. Nat. Bur. Stands., Vol. 27, No. 5, Nov., 1941, pp. 469-477.) (98/36 U.S.A.)

The Planoflex, a simple device for measuring the extent to which a fabric can be distorted in its own plane without producing wrinkles on its surface, was developed to evaluate the pliability of woven fabrics. Results of measurements on a series of cotton percales show an 88 per cent. correlation with their tactual pliability ratings. Comparison of the Planoflex with the Schiefer Flexometer and the Peirce Hanging-Heart Loop methods for evaluating pliability showed it to be as good as or better than these instruments with respect to the extent of the correlation between measured values and tactual pliability ratings, sensitivity to small differences in pliability, and ease of operation. The Planoflex may be used for testing all woven fabrics except those that are heavily starched.

*The Behaviour of Materials of Structural Elements Under Static and Dynamic Load.* (B. Haas, Luftwissen, Vol. 8, No. 11, Nov., 1941, pp. 338-343.) (98/37 Germany.)

After discussing the behaviour of various ductile and brittle materials under single and multiple tensile stresses, the author deals with the complications arising if the stress is periodic (fatigue), or sudden (impact). In connection with fatigue, both the Wohler and so-called " damage " curves are discussed. The letter (German " Schadenslinie ") gives the overload which the material will stand for a given number of cycles without affecting its ultimate fatigue limit. It is interesting to note that certain kinds of surface treatment such as cadmium plating or heavy chromium deposits seriously reduce the fatigue strength of the parent metal, whilst phosphate layers or synthetic lacquers (stored) produce no deleterious effects.

Considerate space is given to a discussion on notch sensitivity and inherent stress distribution. The latter can be controlled by thermal (*e.g.*, case-hardening) or mechanical means (rolling or shot blasting). In each case the size of the structural element plays an important part and this shows the importance oi carrying out tests on samples approximating to practical dimensions.

*The Corrosion of Steel and Various Alloys by High Temperature Steam.* (H. L. Solberg and others, J. Am. Soc. Nav. Engs., Vol. 53, No. 4, November, 1941, pp. 705-723.) (98/38 U.S.A.)

1. The resistance of alloy steels to high temperature steam is greatly influenced by the amount of chromium present. Alloy steels containing 7 per cent. or more

of chromium are very resistant to corrosion produced by steam at temperatures up to at least 1,400°F. The 18-8 stainless steels showed practically no corrosion when subjected to steam at temperatures up to 1,400°F.

2. The corrosion rate is very rapid during the first 500 hours of testing and then gradually diminishes as the time of exposure to the seam continues.

3. Steam temperatures greatly influence the corrosion of steels. Except for steels containing 7 per cent. or more of chromium the corrosion rate increases very rapidly at temperatures in excess of 1,100°F.

4. The steels tested may be grouped into three general classes according to the type of scale formed. The first group consists of low carbon steel, carbon-moly, and the low chromium steels which are covered with a thick, porous, tightly adhering scale. The scale which forms on the steels of the second group, that is the 4-6 Cr steels and the 2 Cr-Moly-Al-Si steel, is very brittle and easily flakes off under fluctuating temperatures. The third group consists of steels having a chromium content of 7 per cent. or more upon which a very thin, non-porous, tightly adhering scale is formed.

5. Scale formed on the inner surface of a tube does not flake off as readily as the scale formed on the outer surface of a tube.

6. Steam pressures between 100 and 1,200 psi gauge have no influence on the corrosion of steels.

*Determination of Strain Distribution by the Photo-Grid Process.* (G. A. Brewer and R. B. Glassco, J. Aeron. Sci., Vol. 9, No. 1, Nov., 1941, pp. 1-7.) (98/39 U.S.A.)

The purpose of this paper is to describe the photo-grid process, a new method of measuring local deformations. The process consists of photographing a pattern of lines upon a sensitised specimen which is then tested and the amount of deformation determined by measuring the new spacing of the lines. Gauge lengths as small as 0.01 inch are used. By this process the strain distribution in tensile specimens of aluminium alloys has been plotted; also the strains produced by several forming operations have been determined. The maximum local elongation measured in tensile test specimens is much higher than the average in two inches and if indicative of the elongations obtained in forming operations of simple bending or stretching. In deep drawn shells even higher strains were measured. The phenomenon of progressive strain hardening with reference to the strain distribution found in the tensile test specimens discussed.

*Beryllium as a Light Metal Component.* (C. B. Sawyer, The Metallurgist (Supp. to Engineer), 26/12/41, pp. 48.) (98/40 Great Britain.)

The Brush Beryllium Company (U.S.A.) has developed methods of production of the metal of guaranteed purity 96 per cent., which may be raised to as high a value as 99.94 per cent. Sawyer and Kjellgren recorded the properties of 99.5 per cent. beryllium, the impurities being aluminium, iron, magnesium, carbon, and silicon. Its density was 1.84, specific heat 0.475, and linear coefficient of expansion $13.3 \times 10^{-6}$. In the cast condition it had a tensile strength of 7.6 to 9.3 tons per square inch, and elongation nil. As forged at 900-1,000 deg. Cent. (0.75 in. to 0.36 in. diameter), its tensile strength was 13.3 tons per square inch, and, after annealing at 1,000 deg. Cent. in hydrogen, 12.0 tons per square inch, the specimens in both cases breaking with no measurable elongation. Determinations of the modulus of elasticity gave results varying from $42.6 \times 10^6$ lb. per square inch for the cast alloy to $36.8 \times 10^6$ lb. per square inch for the forged and annealed bar. The only practical use suggested for the pure metal is to replace aluminium as " windows " for X-ray tubes, beryllium being said to be seventeen times as penetrable to X-rays as is aluminium.

For the past four or five years the Aluminium Company of America, in co-operation with J. B. Johnson, Chief of the Materials Laboratory of the War

Department, Wright Field, and with the Brush Beryllium Company, has been carrying out an extensive investigation of beryllium-aluminium alloys, aimed at the production of a better piston material.

In general the alloys possessing a moderate elongation have nothing in their favour except a high modulus of elasticity (14 to $16 \times 10^6$ lb. per square inch, as compared with about $10 \times 10^6$ lb. per square inch for aluminium alloys). This is not sufficient to compensate for their lower strength at room temperature, though at 600 deg. Fah. their tensile properties are more favourable. There are also serious casting difficulties and the author concludes that there is no future for Be-Al alloy.

*Metal Spraying—Fundamentals and Applications.* (R. L. Dennison, J. Am. Soc. Nav. Engs., Vol. 50, No. 1, February, 1938, pp. 85-106.) (98/41 U.S.A.)

Though oxidation may be lessened by using a reducing flame and holding the pistol close to the work, this has been found impracticable. The spraying of 0.9 per cent. carbon steel on a bar of 0.30 per cent. carbon steel, and substituting nitrogen for air as the impelling medium has shown improvement in the structure of the sprayed coating and signifies reduction in oxidation.

Another theory is that little or no oxidation takes place during spraying, but that each particle is oxidised after deposition. Investigations on the oxidation of sprayed copper coatings show that the substitution of nitrogen for air does not give appreciable effect in reducing the amount of oxides formed. The powder system of spraying is stated to give more oxidation than the wire system, however, as there is no general agreement on the improvement through using nitrogen instead of air, and the cost of using the former would offset any gain; it is now believed that preheating the surface tends to encourage the formation of an oxide film, and is therefore generally practised.

*Metal Spraying—Processes and Some Characteristics of the Deposits.* (C. E. Rollason, Journal of the Institute of Metals, Vol. 60, No. 1, 1937, pp. 35-54.) (98/42 U.S.A.)

Spraying pistols, using wire, powder, and molten metal are described, together with comparative details. The nature of the sprayed deposit is discussed. A few corrosion tests using intermittent salt spray have been made on zinc and aluminium deposits and on painted zinc coats.

Using the three types of pistol, comparative tests of aluminised surfaces have been made and heat-treated nickel-chromium-iron coatings were found to have good resistance to oxidation at elevated temperatures. Data also given for porosity, oxide content of sprayed copper, and hardness of sprayed metals.

The hardness of sprayed deposits is becoming more important owing to the increased use of the process in the building up of worn articles. It is greatly affected by the amount of oxide and porosity of the coat, because a material full of pores has less resistance to penetration than sound metal, consequently yielding a lower Brinell number. On the other hand, oxide particles in the same material tend to give a high scratch hardness. In mild steel the oxide present as sprayed makes the material almost unmachinable, but annealing decreases the hardness due to agglomeration of oxide. It was found when using a wire pistol, that the hardness was increased by increasing the speed of wire feed, by higher oxygen pressure and also, to a less degree, by higher hydrogen pressure, optimum values being given.

There are many different opinions in the literature on the subject regarding the oxide content of the sprayed deposit. To obtain deposits low in oxide it would appear advisable to use a slightly reducing flame and to reduce the nozzle distance so far as it is possible without overheating the base. Unfortunately, a pistol using a reducing flame, is not working at its maximum efficiency. The practice of preheating the article advocated some ten years ago is now seen to be undesirable.

In one German pistol carbon dioxide is used for atomising in the case of low melting point metals, and the use of nitrogen instead of air has also been suggested but not worked commercially.

*Control Problems* (*Parts* 1 *and* 2). (N. Minorsky, J. Frank. Inst., Vol. 232, No. 5, Nov., 1941, pp. 451-487.) (98/43 U.S.A.)

CONTENTS.



*Control Problems* (3 *and* 4). (N. Minorsky, J. Frank. Inst., Vol. 232, No. 6, Dec., 1941, pp. 519-551.) (98/44 U.S.A.)

## Part IV.

### Non-Linear Control Problems.



*Measurement of Loop Antenna Receivers.* (W. O. Swinyard, Procs. of the I.R.E., Vol. 29, No. 7, July, 1941, pp. 382-387.) (98/45 U.S.A.)

The most practical method of introducing the measuring signal into loop receiveds is to employ a transmitting loop connected to the signal generator. Several such loops are described, varying with regard to the use of shielding, frequency range covered, method of computing the field strength produced, and other particulars. The types described in the latter part of the paper are in use and giving satisfactory service at the present time. Precautions against stray fields and near-by metal objects are discussed briefly. Measurements on receiving loops, aside from general receiver tests, are described and formulas given. The results of such measurements on three groups of loops, totalling 30 in number, are reported. The paper closes with an appendix giving the derivation of a few formulas of interest.

*Theory of Antennas of Arbitrary Size and Shape.* (S. A. Schelkunoff, Procs. of the I.R.E., Vol. 29, No. 9, Sept., 1941, pp. 493-521.) (98/46 U.S.A.)

In this paper there are presented (1) a quite general method of antenna analysis; (2) a physical picture of transmission phenomena in antennas, based on this method; and (3) an expression for the input impedance of antennas of any shape, whose transverse dimensions are small compared with the wave-length. In a brief historical sketch of the antenna problem the factors which must be taken into consideration in solving the problem are discussed.

In the first approximation, regardless of the shape of the wire the charge is proportional to the voltage and waves are sinusoidal, the current wave having nodes while the voltage wave and the charge wave antinodes at the ends of the antenna. The second approximation depends on the shape of the longitudinal cross section of the antenna as well as on the size of the transverse cross section.

Our analysis is based on Maxwell's equations, but the final results are quite simple and the physical picture growing out of this mathematics is attractive to an engineer. It is permissible to think that a wave emerging from a generator in the centre of an antenna is guided by an antenna until it reaches its " boundary sphere " passing through the ends of the antenna and separating the antenna region from the external space; at the boundary sphere some energy passes into the external space and some is reflected back—a situation existing at the juncture between two transmission lines with different characteristic impedances.

*Life at High Altitudes.* (A. J. Carlson, Nature, Vol. 148, No. 3,765, 27/12/41, pp. 774-776.) (98/47 Great Britain.)

This article contains some interesting observations on delayed opening parachute jumps. In a delayed jump there is no unfavourable effect on heart-rate or blood pressure. Mental reactions are normal in an unfrightened jumper, except for a momentary black-out when the parachute opens, and there is no feeling of nausea. Vision is not impaired if goggles are worn. It is suggested that fright, rather than any basic physiological reaction, is the chief cause of fainting in delayed opening jumps. Safety in delayed drops would therefore be considerably improved by the use of a small guide parachute; this enables the jumper to fall in a more or less erect position, without twisting in mid-air, thus increasing his confidence.

The physiological characteristics of natives of the Andes who live at very high altitudes are also discussed. An interesting fact concerning these men is that though every year 100,000 of them came down to sea-level for agricultural work, they never stay longer than three months in this altitude, since the conditions would prove fatal to them—as in the recent Bolivian-Paraguayan war where the effects of low altitude killed more people than the enemy's bullets.

*Synthetic Production and Control of Acoustic Phenomena by a Magnetic Recording System.* (S. K. Wolf, Procs. of the I.R.E., Vol. 29, No. 7, July, 1941, pp. 365-371.) (98/48 U.S.A.)

In recent years there has been an increasingly active search for an electro-acoustic system for producing and controlling reverberation and associated phenomena. This paper described an electro-magnetic method of producing and controlling reverberation by the use of a magnetic tape recording system. It consists of recording a sound pattern magnetically on steel tape. The signal is picked up from the tape at frequent split-second intervals and reproduced at any desired level or characteristic. The tape is arranged for driving in an endless helical loop. An obliterating head which continuously obliterates the record is placed just before the first recording head. The phenomena of reverberations and the various methods which have been suggested by others for controlling reverberation synthetically, such as the electro-optical, electro-mechanical, mechanical recording, and the reverberation chamber methods, are briefly discussed. The paper also outlines other uses for the magnetic tape system in the study of acoustic phenomena both synthetically and analytically.

## LIST OF SELECTED TRANSLATIONS.

No. 41.

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Lists of selected translations have appeared in this publication since September, 1938.

### AERODYNAMICS.

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| 1354 | Hautsche, W. ... Wendt, W. ... ... | *The Compressible Potential Flow about a Family of Symmetrical Cylinders at Zero Incidence in a Wind Tunnel.* (L.F.F., Vol. 18, No. 9, 20/9/41, pp. 311-316.) |

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| 1322 | —— ... ... | *Tail Brake for Aircraft.* (German Pat. No. 705,891, 17/10/39, published 13/5/41, Dornier Works G.M.b.H. and Dr. C. Dornier, Flugsport Patent Collection No. 8, 9/7/41, p. 32.) |
| 1343 | Weining ... ... | *Airscrews for High Speed Aircraft.* (L.F.F., Vol. 14, No. 4-5, 20/4/37, pp. 168-172.) |
| 1378 | Horten ... ... | *Contribution to the Development of Special Designs for Towing Aircraft (Tugs).* (Deutsche Motor-Zeitschrift, Vol. 8, Aug., 1941.) |

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| 1336 | Poppinga, R. ... | *Protective Layers for the Running Surfaces of Piston Rings.* (Z.V.D.I., Vol. 85, No. 22, 31/5/41, pp. 505-506.) |
| 1337 | Kuhl, H. ... ... | *The Influence of Dissociation of Combustion Gases on the Efficiency of Carburettor Engines.* (Forschungsheft, No. 373, Vol. 6, July-Aug., 1935.) |
| 1341 | Brode, K. ... ... | *Bramo Fafnir Petrol Injection Radial Aero Engines, Types 323 A-D and 323 P.* (Luftwissen, Vol. 8, No. 6, June, 1941, pp. 189-193.) |
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| 1361 | Papok, K. K. and others ... ... | *The Effect of Oiliness of the Lubricant on Piston Ring Wear.* (Aeron. Eng., U.S.S.R., Vol. 15, No. 5-6, May-June, 1941, pp. 57-61.) |
| 1362 | —— ... ... | *The Effect of a High Speed Dive on the Aircraft Power Plant.* (Luftwissen, Vol. 8, No. 8, Aug., 1941, pp. 246-250.) |

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| 1367 | Null, Von d. W. ... Pfau, H. ... ... | *Design and Construction of Aero Engine Superchargers.* (Z.V.D.I., Vol. 85, No. 37-38, 20/9/41, pp. 765-775.) |
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| 1360 | Treffsick, I. I. ... | *Radio Interference on Aircraft.* (Air Fleet News, U.S.S.R., Vol. 23, No. 4, April, 1941, pp. 357-360.) |

## TITLES AND REFERENCES OF ARTICLES AND PAPERS SELECTED FROM PUBLICATIONS RECEIVED IN R.T.P.3 DURING DECEMBER, 1941.

Notices and abstracts from the Scientific and Technical Press are prepared primarily for the information of Scientific and Technical Staffs. Particular attention is paid to the work carried out in foreign countries, on the assumption that the more accessible British work (for example, that published by the Aeronautical Research Committee) is already known to these Staffs.



### Detailed Classification of Principal Items.

Theory and Practice of Warfare. (1-158.)

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## Theory and Practice of Warfare.

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| 108 | 384 | U.S.A. ... | *Anti-Aircraft Artillery in Anti-Mechanised Defence.* (Nelson, Coast Artillery J., Nov.-Dec., 1941, pp. 540-545.) |
| 109 | 385 | Germany ... | *The German Armoured Force.* (Schmidt, Coast Artillery J., Vol. 84, No. 6, Nov.-Dec., 1941, pp. 562-572.) |
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| 152 | 458 | Germany ... | *Messerschmitt* 110 *C.*5 *(Two or Three-Seater) (Photograph).* (La Science et la Vie, Vol. 60, No. 287, July, 1941, p. 29.) |
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| 163 | 307 | Great Britain | *Boundary Layer Research in Great Britain (N.P.L.).* (Flugsport, Vol. 33, No. 25 (Profile Coll. No. 34), 10/12/41, pp. 139-140.) |
| 164 | 330 | Sweden ... | *Swedish Aeronautical Research Laboratory at Bromma.* (Inter. Avia., No. 791, 18/11/41, p. 18.) |
| 165 | 347 | Germany ... | *The Critical Surface Roughness for a Laminar Boundary Layer (from Tokio Research Dept. No.* 199). (Flugsport, Vol. 33, No. 24, Profile Collection No. 33, 26/11/41, pp. 134-136.) |
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| 175 | 30116 | Germany ... | *The Balancing of Airscrews (II).* (Der Flieger, Vol. 20, No. 7, July, 1941, pp. 232-233.) |
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| 177 | 5 | Great Britain | *Rotol Jablo Wood Airscrew Blades.* (W. Brierly, Aeroplane, Vol. 61, No. 1,596, pp. 704-705, Dec., 1941.) |

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| 189 | 176 | Italy ... | *Campini C.C. 2 Jet Propulsion Aircraft (Photograph).* (Aeroplane, Vol. 62, No. 1,599, 16/1/42, p. 60.) |
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| 191 | 194 | Great Britain | *Saunders Tube Control (Push, Pull and Rotary).* (Flight, Vol. 41, No. 1,723, 1/1/42, pp. 16-17.) |
| 192 | 197 | Great Britain | *Portable Runways (Metal Gratings).* (Flight, Vol. 41, No. 1,723, 1/1/42, p. 19.) |
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| 211 | 295 | Germany ... | *Control Valve for Pressure Cabins. (Pat. No.* 705,844.) (Arado, Flugsport, Vol. 33, No. 14 (Pat. Coll. No. 8), 9/7/41, p. 29.) |
| 212 | 296 | Germany ... | *Pressure Cabins (Built in Pattern). (Pat. No.* 705,929.) (Dornier, Flugsport, Vol. 33, No. 14 (Pat. Coll. No. 8), 9/7/41, p. 29.) |

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| 214 | 298 | Germany ... | *Roller Bearing for Aircraft Control Rods.* (*Pat. No.* 706,518.) (Henschel, Flugsport, Vol. 33, No. 14 (Pat. Coll. No. 8), 9/7/41, p. 30.) |
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| 217 | 302 | Germany ... | *Control System for Wing Brakes (Aerodynamic).* (*Pat. No.* 705,499.) (Messerschmitt, Flugsport, Vol. 33, No. 14 (Pat. Coll. No. 8), 9/7/41, p. 32.) |
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| 219 | 309 | Germany ... | *Shock Absorber Incorporated in Wheel Axis.* (*Pat. No.* 712,774.) (V.D.M., Flugsport, Vol. 33, No. 25 (Pat. Coll. No. 18), 10/12/41, pp. 73-74.) |
| 220 | 310 | Germany ... | *Undercarriage Fairing which is Jettisoned Before Retraction of Wheels.* (*Pat. No.* 712,717.) (Messerschmitt, Flugsport, Vol. 33, No. 25 (Pat. Coll. No. 18), 10/12/41, pp. 74-75.) |
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| 225 | 326 | Germany ... | *New German Aircraft Types (Do. 217 and Do. 172).* (Inter. Avia., No. 791, 18/11/41, pp. 15-16.) |
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| 228 | 344 | Italy ... | *Muscular Flight Aircraft "Mazzei."* (Flugsport, Vol. 33, No. 24, 26/11/41, p. 463.) |
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| 230 | 349 | Germany ... | *Patent Collection No. 17. Pressure Cabin (Shell Curvature Ensures Tensile Stresses Only)* (713,118). (Flugsport, Vol. 33, No. 24, 26/11/41, p. 69, D.V.L.) |

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| 233 | 354 | Germany ... | *Aircraft Control Linking Flaps and Adjustable Horizontal Tailplane* (712,287). (Dornier, Flugsport, Vol. 33, No. 24, 26/11/41, pp. 71-72.) |
| 234 | 355 | Germany .. | *Stabilisation of Helicopters in which Rotors are not Co-Axial* (712,878). (Henschel, Flugsport, Vol. 33, No. 24, 26/11/41, p. 72.) |
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| 236 | 392 | Italy ... | *Campini Jet Propulsion Trial Flight* (130 *m.p.h.*). (Inter. Avia., No. 793, 5/12/41, p. 7.) |
| 237 | 420 | France ... | *Muscular Flight—the Schoedal Apparatus.* (La Science et la Vie, Vol. 60, No. 290, Oct., 1941, p. 241.) |
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| 239 | 423 | U.S.A. ... | *Development of the Two-Seat Civil Aircraft Ercoupe (Two Control Operation).* (F. E. Weick, S.A.E.J., Vol. 49, No. 6, Dec., 1941, pp. 520-531.) |
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